[0003]

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Summary of Invention

Technical Problem

[0004]

A lift generator capable of further decreasing power for rotating a propulsion propeller is desired.

Embodiments of the present invention provide a lift generator capable of propelling a ship more largely in a case where a propulsion propeller is rotated by the same power as that of the lift generator (duct) of the related art.

Solution to Problem

[0005]

According to an aspect of the present invention, there is provided a lift generator which is positioned in front of a propulsion propeller in a ship having the propulsion propeller, in which the lift generator includes a wall portion which extends in a circumferential direction around an extension line of a center axis of the propulsion propeller, the wall portion having a flow path which penetrates in a direction of the extension line and is formed inside the wall portion, a shape of a cross section of the wall portion by a virtual plane

including the extension line is an airfoil shape in a set range in the circumferential direction wherein a lift including a forward component is generated in the airfoil shape, in the airfoil shape, an outer surface forming an outer peripheral surface of the wall portion is bent inward so as to form a recess, a thickness of the airfoil shape gradually decreases from a set position at which the thickness becomes the maximum value toward a rear side, and the airfoil shape satisfies $|dt/dx| \leq 0.15$ over an entire range from the set position to a trailing edge of the airfoil shape, in the inequality, dx indicates a minute change amount of a positional coordinate x in a chord direction of the airfoil shape, dt indicates a minute change amount of a thickness t with respect to dx, and $|dt/dx|$ indicates a magnitude of dt/dx.

[0006]

In embodiments of the present invention, in the airfoil shape, the outer surface forming the outer peripheral surface of the wall portion is bent inward so as to form the recess. Accordingly, in the airfoil shape, a circulation of a flow increases, and as a result, a pressure on the inner surface decreases and a lift increases. According to the increase in the lift of the airfoil shape, a forward component of the lift of the airfoil shape increases (hereinafter, this effect is referred to as an increase effect in a lift forward component).

[0007]

In addition, in embodiments of the present invention, a

magnitude of the ratio dt/dx between the minute change amount dx at the position x in the chord direction and the minute change amount dt of the thickness t at the position x is 0.15 or less over the entire range from the set position to the trailing edge (units of dx and dt are the same as each other). Accordingly, even when the above-described recess is formed, a fluid resistance of the airfoil shape is kept small (hereinafter, this effect is referred to as a fluid resistance reduction effect).

[0008]

Compared to a lift generator of the related art, in embodiments of the present invention, according to the above-described forward component increase effect of the lift and the above-described fluid resistance reduction effect, it is possible to propel the ship more largely by the same power (for example, refer to comparison of Comparative Examples 1 and 2 described later).

[0009]

The above-described lift generator may be configured as follows.

[0010]

In the airfoil shape, each of the outer surface and an inner surface forming an inner peripheral surface of the wall portion is curved toward the flow path side as a whole.

[0011]

In this way, each of the outer surface and the inner

surface of the airfoil shape is curved inside as a whole. Accordingly, a fluid is easily separated from the airfoil shape (particularly, inner surface), and thus, the fluid which has passed through the lift generator is disturbed and a flow rate of the fluid decreases. Therefore, the water stream having the reduced flow rate flows into the propulsion propeller. As a result, efficiency of the propulsion propeller is improved (hereinafter, this effect is referred to as a propeller efficiency improvement effect).

[0012]

Accordingly, compared to a lift generator of the related art, in embodiments of the present invention, according to the above-described increase effect of the lift forward component, the above-described fluid resistance reduction effect, and the above-described propeller efficiency improvement effect, it is possible to propel the ship more largely by the same power.

[0013]

The wall portion includes a lower end portion in which the outer peripheral surface faces vertically downward, and in the direction of the extension line, a length of the lower end portion is shorter than a length of an upper end portion of the wall portion.

[0014]

In the wall portion, a drag is easily generated in the lower end portion in which the outer peripheral surface faces vertically downward.

Meanwhile, according to the above-described embodiment, in the wall portion, the length of the lower end portion is shorter than the length of the upper end portion, and thus, the drag in the lower end portion is suppressed.

[0015]

A shape of the cross section of the lower end portion is an airfoil shape with no recess, or is not an airfoil shape.

[0016]

As described above, the cross section of the recess or the airfoil shape is not required in the lower end portion in which the drag is generated. Accordingly, the cross sectional shape of the lower end portion is able to be simplified.

[0017]

The set range includes at least a portion of a circumferential range in which the outer peripheral surface of the wall portion faces obliquely upward.

[0018]

In this range, a large lift is generated in the airfoil shape.

Advantageous Effects of Invention

[0019]

According to embodiments of the present invention, the outer surface of the airfoil shape is bent inward so as to form the recess, and thus, a large lift is generated in the airfoil shape. As a result, the forward component of the lift of the

airfoil shape increases.

In addition, the magnitude of the ratio dt/dx between the minute change amount dx at the position x in the chord direction and the minute change amount dt of the thickness t at the position x is 0.15 or less over the entire range from the set position to the trailing edge. Accordingly, even when the above-described recess is formed, a fluid resistance of the airfoil shape is kept small.

Compared to the lift generator of the related art, in embodiments of the present invention, according to the increase of the forward component of the lift and the fluid resistance reduction of the airfoil shape, it is possible to propel the ship more largely by the same power.

Brief Description of Drawings

[0020]

Fig. 1A illustrates a stern of a ship to which a lift generator according to an embodiment of the present invention is applied.

Fig. 1B is a view when viewed in a direction of arrows B-B in Fig. 1A.

Fig. 2A is a cross sectional view taken along line II-II of Fig. 1B.

Fig. 2B is a cross sectional view taken along line II-II of Fig. 1B and illustrates another characteristic of

CLAIMS

1. A lift generator which is positioned in front of a propulsion propeller in a ship having the propulsion propeller,

wherein the lift generator includes a wall portion which extends in a circumferential direction around an extension line of a center axis of the propulsion propeller, the wall portion having a flow path which penetrates in a direction of the extension line and is formed inside the wall portion,

wherein a shape of a cross section of the wall portion by a virtual plane including the extension line is an airfoil shape in a set range in the circumferential direction wherein a lift including a forward component is generated in the airfoil shape,

wherein in the airfoil shape, an outer surface forming an outer peripheral surface of the wall portion is bent inward so as to form a recess,

wherein a thickness of the airfoil shape gradually decreases from a set position at which the thickness becomes the maximum value toward a rear side, and

wherein the airfoil shape satisfies $|dt/dx| \leq 0.15$ over an entire range from the set position to a trailing edge of the airfoil shape, in the inequality, dx indicates a minute change amount of a positional coordinate x in a chord direction of the airfoil shape, dt indicates a minute change amount of a thickness t with respect to dx, and $|dt/dx|$ indicates a magnitude of dt/dx.

2. The lift generator according to claim 1,

wherein in the airfoil shape, each of the outer surface and an inner surface forming an inner peripheral surface of the wall portion is curved toward the flow path side as a whole.

3. The lift generator according to claim 1 or 2,

wherein the wall portion includes a lower end portion in which the outer peripheral surface faces vertically downward, and

wherein in the direction of the extension line, a length of the lower end portion is shorter than a length of an upper end portion of the wall portion.

4. The lift generator according to claim 3,

wherein a shape of the cross section of the lower end portion is an airfoil shape with no recess, or is not an airfoil shape.

5. The lift generator according to any one of claims 1 to 4,

wherein the set range includes at least a portion of a circumferential range in which the outer peripheral surface of the wall portion faces obliquely upward.